

CLAIMS

We claim:

1. A method for cleaning one or more membranes normally immersed in a water containing solids in a tank and used to produce a permeate comprising:
- performing cleaning events having the steps of:
- (a) stopping permeation;
- (b) flowing a selected concentration of a chemical cleaner through the membranes in a direction opposite to the direction in which permeate passes through the membranes, while the membranes remain immersed in the water containing solids, in repeated pulses followed by waiting periods, the repeated pulses and waiting periods in a cleaning event cumulatively having a selected duration; and,
- (c) resuming permeation;
- wherein the membranes are not agitated while the chemical cleaner is flowed through the membranes.
2. The method of claim 1 repeated at least once per week.
3. The method of claim 2 wherein the product of the concentration of the chemical cleaner expressed as an equivalent concentration of NaOCl in cleaning efficacy and the duration of the pulses and waiting periods in a week is between 2,000 minutes•mg/L and 30,000 minutes•mg/L.
4. The method of claim 3 wherein the product of the concentration of the chemical cleaner expressed as an equivalent concentration of NaOCl in cleaning efficacy and the duration of the pulses

and waiting periods in a week is between 2,000 minutes•mg/L and 20,000 minutes•mg/L.

5. The method of claim 2 wherein the water lean in solids is intended for drinking water and the product of the concentration of the chemical cleaner expressed as an equivalent concentration of NaOCl in cleaning efficacy and the duration of the pulses and waiting periods in a week is between 5,000 minutes•mg/L and 10,000 minutes•mg/L.

6. The method of claim 2 wherein the water rich in solids is a wastewater and the product of the concentration of the chemical cleaner expressed as an equivalent concentration of NaOCl in cleaning efficacy and the duration of the pulses and waiting periods in a week is between 10,000 minutes•mg/L and 30,000 minutes•mg/L.

7. The method of claim 1 wherein the pulses last for between 10 seconds and 100 seconds and the waiting periods last for between 50 seconds and 6 minutes.

8. The method of claim 1 wherein the pulses last for between 10 seconds and 100 seconds and the waiting periods last for between 50 seconds and 3 minutes.

9. The method of claim 1 wherein the length of the pulses is selected to provide chemical cleaner in an area in and adjacent to the membranes with an initial efficacy and the length of the waiting periods is selected to provide substantially effective chemical cleaner in an area in and adjacent to the membranes during the waiting period.

10. The method of claim 1 wherein the membranes are hollow fibre membranes and the pressure of the pulses is between 5 kPa and 55 kPa above the pressure on the outside of the membranes.

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11. The method of claim 10 wherein the flow through the membranes during the pulses is between 8.5 and 51 L/m<sup>2</sup>/h/bar.

12. The method of claim 1 wherein chemical cleaner is removed from the tank as retentate before permeation is resumed.

5 13. The method of claim 12 wherein substantially all of the chemical cleaner removed from the tank as retentate before permeation is resumed.

10 14. The method of claim 1 wherein a permeate pump is used to flow the selected concentration of cleaning chemical through the membranes.

15 15. A method for cleaning one or more membranes immersed in water rich in solids and used to permeate a water lean in solids wherein each cleaning event comprises the steps of:

15 (a) stopping permeation and agitation of the water containing solids;

(b) flowing a chemical cleaner through the membranes in a direction opposite to the direction in which permeate passes through the membrane;

(c) resuming permeation; and,

20 (d) resuming agitation,

and wherein permeate collected before resuming agitation is wasted or recycled to the water containing solids and wherein the membranes and the membranes remain immersed during steps (a), (b), (c) and (d).

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16. A method for cleaning one or more filtering membranes normally immersed in tank water containing solids in a tank and used to produce a permeate in one or more cleaning events, each cleaning event comprising the steps of:

- 5 (a) stopping permeation;  
(b) draining the tank water from the tank to below the level of the membranes; and,  
(c) flowing a chemical cleaner in pulses through the membranes in a direction opposite to the direction in  
10 which water lean in solids normally permeates through the membranes; and,  
(d) refilling the tank,  
wherein,  
(e) the cleaning events are performed at least once a week;  
15 and,  
(f) the product of the concentration of the chemical cleaner expressed as an equivalent concentration of NaOCl in cleaning efficacy and the duration of all cleaning events in a week is between 2,000 minutes\*mg/L and 20,000 minutes\*mg/L.

20 17. The invention of claim 16 wherein the pulses have a pressure which minimizes the relative size of local pressure variations between membranes or portions of membranes in different parts of the tank.

18. The invention of claim 16 wherein the pulses have a  
25 pressure between 10 kPa and 55 kPa.

19. The invention of claim 16 wherein the membranes are vertically oriented hollow fibres fluidly connected to at least an upper header and the chemical cleaner flows into the membranes only through

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the upper header.

20. The invention of claim 19 wherein the pulses have a pressure between 10 kPa and 55 kPa.

21. The invention of claim 20 wherein the flux of chemical  
5 cleaner through the membranes is between 30 and 55 L/m<sup>2</sup>/h/bar.

22. The invention of claim 16 wherein the time between pulses is insufficient to allow the membranes to dry substantially from an initial wetted state and the duration of the flow of chemical cleaner in the pulses allows the membranes to be re-wetted to the initial state.

10 23. The invention of claim 22 wherein in each pulse the chemical cleaner flows for between 10 seconds and 120 seconds and does not flow for between 30 seconds and five minutes.

24. The invention of claim 16 wherein the flow of chemical cleaner is provided by a pump and the speed of the pump is controlled to  
15 maintain a preselected pressure of the pulses.

25. The invention of claim 23 wherein the time during which the pump is on in each pulse is decreased if the flux of the chemical cleaner increases from an initial value.

26. A process for filtering water containing solids with  
20 membranes in a tank comprising the steps of:

a) filling the tank with a feed water to be filtered to immerse the membranes;

b) creating a transmembrane pressure between a permeate side and a retentate side of the membranes, the retentate side of the  
25 membranes being in contact with the water in the tank, the permeate side

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being fluidly connected to a filtered permeate outlet, to generate a filtered permeate at the permeate outlet;

c) aerating the membranes to dislodge solids from the membranes;

d) backwashing the membranes;

e) draining the tank; and,

f) performing the steps above in repeated cycles

wherein the steps of backwashing the membranes and draining the tank may be performed either before the other or partially or substantially simultaneously and the step of backwashing the membranes in the repeated cycles periodically involves backwashing with a cleaning chemical having a selected concentration for a selected duration.

27. The invention of claim 26 wherein the step of backwashing the membranes in the repeated cycles involves backwashing with a cleaning chemical having a selected concentration between once a day and once a cycle.

28. The invention of claim 26 wherein the sum of the products of the concentration of the cleaning chemical and the duration of the steps of backwashing with a cleaning chemical performed in a week is selected to maintain an acceptable permeability of the membranes or to reduce the rate of decline in permeability of the membranes over extended periods of time.

29. The invention of claim 26 wherein the sum of the products of the concentration of the cleaning chemical and the duration of the steps of backwashing with a cleaning chemical performed in a week is between 2,000 min•mg/l and 20,000 min•mg/l when NaOCl is the cleaning chemical or an equivalent product of concentration and time of another cleaning chemical.

30. The invention of claim 29 wherein the sum of the products of the concentration of the cleaning chemical and the duration of the steps of backwashing with a cleaning chemical performed in a week is between 5,000 min•mg/l and 10,000 min•mg/l when NaOCl is the cleaning chemical or an equivalent product of concentration and time of another cleaning chemical.

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